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Abstract

This report updates the description of the space geodesy facilities of the Spanish National Geographic Institute (IGN). The current 40-m radio telescope at Yebes, a network station for IVS, has performed geodetic VLBI observations regularly since September 2008. In addition to this, the project to establish an Atlantic Network of Geodynamical and Space Stations (RAEGE) is progressing with the construction of the first antenna, to be erected in Yebes in 2012.

1. General Information: the IGN Facilities at Yebes

Yebes Observatory, a department of the Instituto Geográfico Nacional (IGN, Ministerio de Fomento), holds two radio telescopes: the new 40-m which is a network station for IVS, and the old 14-m used between 1995 and 2003. Yebes Observatory is also the reference station for the Spanish GNSS network and holds permanent facilities for gravimetry. The RAEGE project will provide a new VLBI2010-type antenna in Yebes as soon as 2012. An SLR system in a new control building will also be built in the near future.

2. IGN Staff Working on VLBI Projects

Table 1 lists the IGN staff who are involved in space geodesy studies and operations. The VLBI activities are also supported by other staff such as receiver engineers, computer managers, secretaries, and students. In 2011, the process of hiring dedicated telescope operators was finally concluded, increasing the operational efficiency of the instrument also for its participation in geodetic VLBI campaigns.

Table 1. Staff in the IGN VLBI group (e-mail: vlbitech@oan.es).

Name	Background	Role	Address*
Francisco Colomer	Astronomer	VLBI Project coordinator	IGN
Susana García–Espada	Engineer	geoVLBI expert	CAY
Jesús Gómez–González	Astronomer	Deputy Director for Astronomy, Geodesy and Geophysics	IGN
José Antonio López–Fdez	Engineer	Yebes site manager	CAY
Javier López–Ramasco	Geodesist	Geodesist	CAY
Alvaro Santamaría	Geodesist	Geodesist	CAY
Pablo de Vicente	Astronomer	VLBI technical coordinator	CAY

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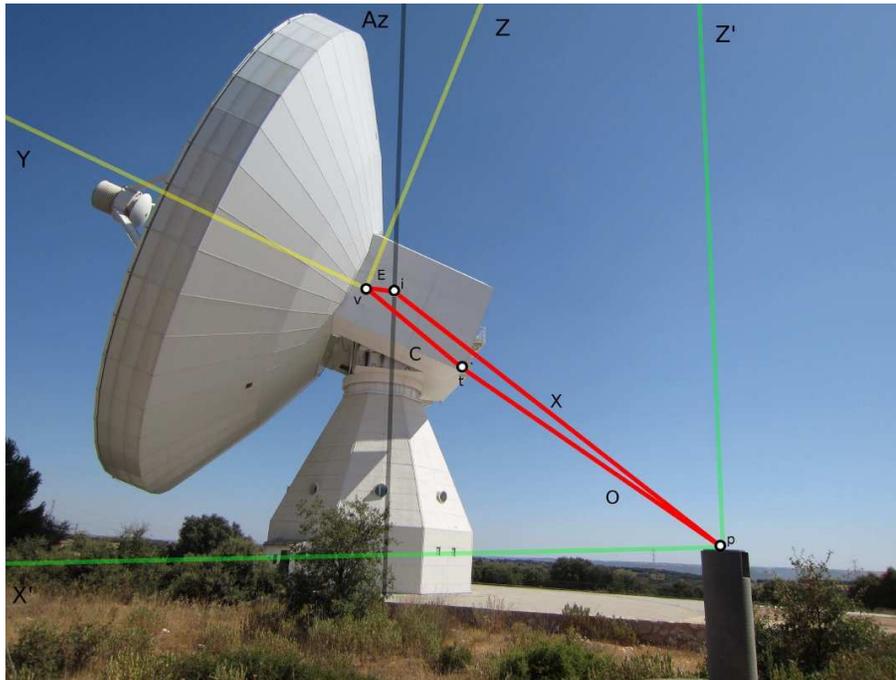


Figure 1. Geometric approach to determine the location of the Invariant Reference Point of the 40-m radio telescope at Yebes observatory.

3. Status of Geodetic VLBI Activities at IGN

The 40-m radio telescope has participated in 21 sessions of the EURO, R4, and T2 series as well as in the whole CONT11 campaign on September 15-30, 2011.

The studies of the tropospheric effect caused by neutral atmosphere continues in cooperation with the geodesy group at Onsala Space Observatory in Sweden, by using the HIRLAM 3D-VAR numerical weather prediction model; the slant delay caused by the neutral atmosphere is calculated via ray-tracing (see García-Espada, Haas and Colomer 2011).

A simulation has been produced to assess to what extent an automatic system based on robotic total stations could be properly configured to continuously monitor the Invariant Reference Point of the 40-m radio telescope at the Yebes observatory, using a geometric model that improves the classical 3D circle fitting methods. This approach is able not only to accurately estimate the IRP coordinates and other parameters (e.g., eccentricity and non-orthogonality of the axes), but also it allows monitoring of its temporal behavior, thus providing fundamental information about the radio telescope deformation. Indeed, one robotic total station would allow reliable estimation of the IRP coordinates in 24h observation batches, provided that the precision of the observed target coordinates is better than 1 cm (see Santamaría-Gómez and García-Espada 2011).

A new high-speed Internet connection has been built to connect Yebes to GÉANT. Running at 1 Gbps since April 2009, the new dark fiber will allow data transfer of 10 Gbps starting in 2012.

Figure 2 shows the new gravimeter pavillion, which permanently holds an absolute gravimeter and a GWR superconducting gravimeter installed in May 2010.



Figure 2. The A10 absolute and GWR superconducting gravimeters installed in a dedicated building in Yebes. (Figure courtesy of Carlos Albo Castaño, IGN).

4. Project RAEGE

As mentioned in the previous report, IGN (together with the Portuguese colleagues in DSCIG) is constructing a network of four new Fundamental Geodynamical and Space Stations in Spain and Portugal (Azores Islands). The project, named *RAEGE* (after “**R**ed **A**tlántica de **E**staciones **G**eodinámicas y **E**spaciales”), consists of the erection of one radio telescope of VLBI2010 class (i.e., of 13.2-m diameter, having a high slew rate, and capable of operating in the 2-14 GHz bands but also up to 90 GHz), a permanent GNSS receiver, and a gravimeter in Yebes, Tenerife (Canary Islands), Santa María and Flores (Azores Islands), and an SLR station in Yebes (see e.g. Gómez-González et al. 2011).

The construction of three antennas, to be installed in Yebes, Azores (Santa María), and Canary Islands, and contracted to MT Mechatronics (Germany), has started (see Figure 3). The first antenna will be erected in Yebes in 2012, shortly followed by the antenna in Santa María.

Radio frequency interference (RFI) has been monitored at Yebes and the other chosen sites, demonstrating that in the latter cases the spectrum in the bands of interest is very clean.

Meanwhile, preliminary studies, concerning the installation of a Satellite Laser Ranging system in Yebes, have started (see Vaquero Jiménez and López Fernández 2011).



Figure 3. RAEGE telescopes under construction in Spain. Left: receiver cabins. Right: antenna counterweights.

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